

Seminár Robotika.SK

Od konvolučného autoencoderu k sémantickej segmentácii

Andrej Lúčny

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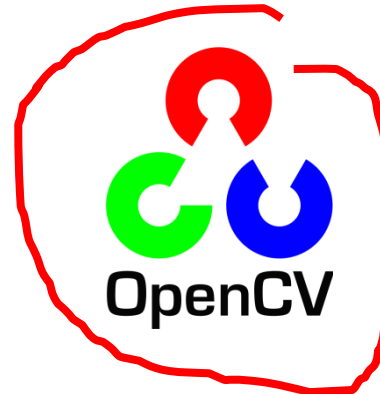
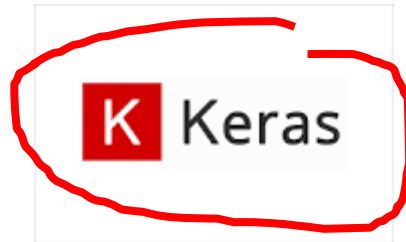
lucny@fmph.uniba.sk

http://dai.fmph.uniba.sk/w/Andrej_Lucny

www.robotika.sk/seminar/2020/cvicenie12.zip

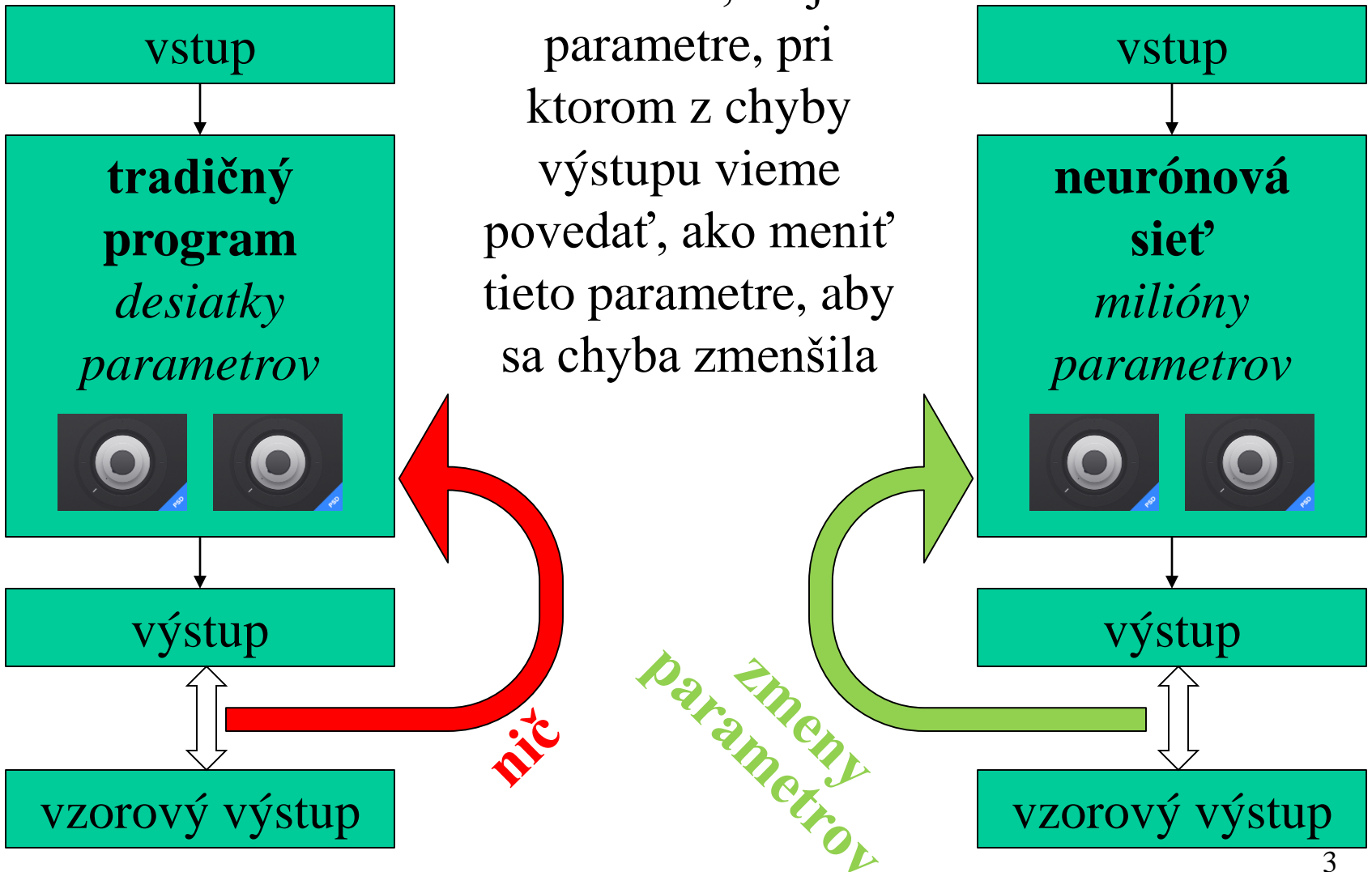
Nástroje Deep Learningu

Caffe

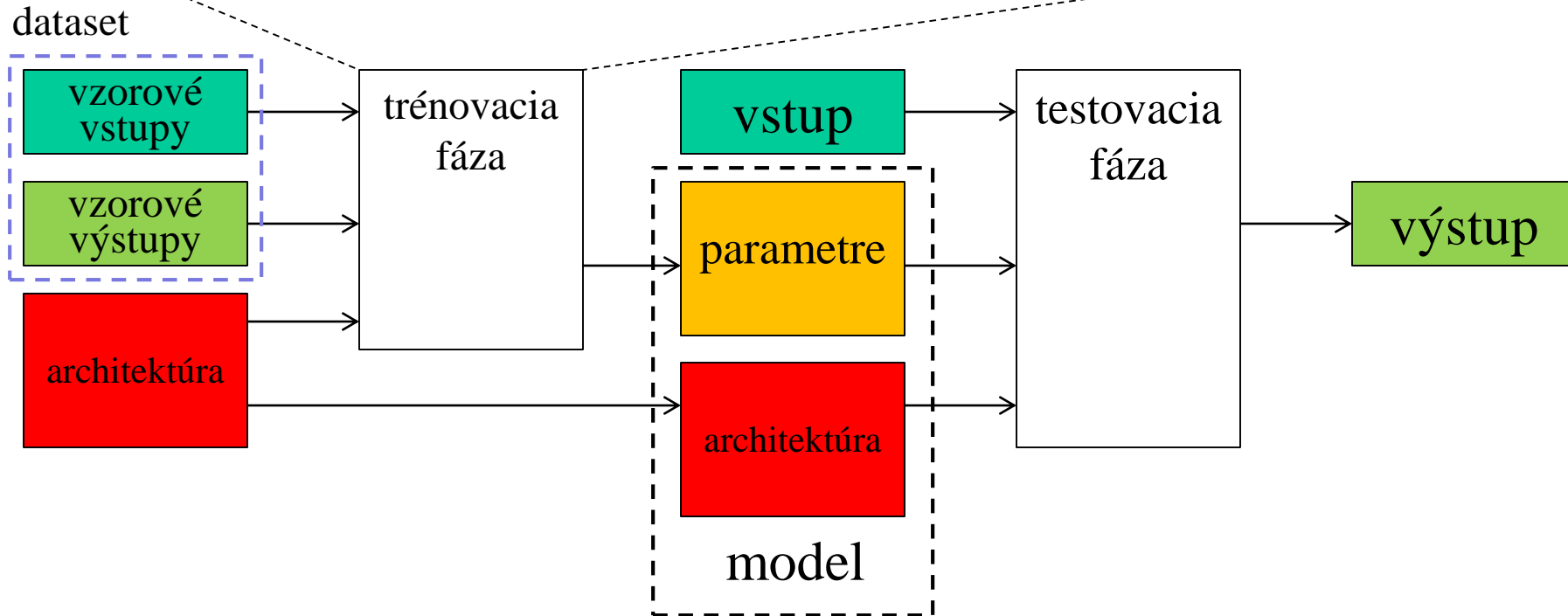
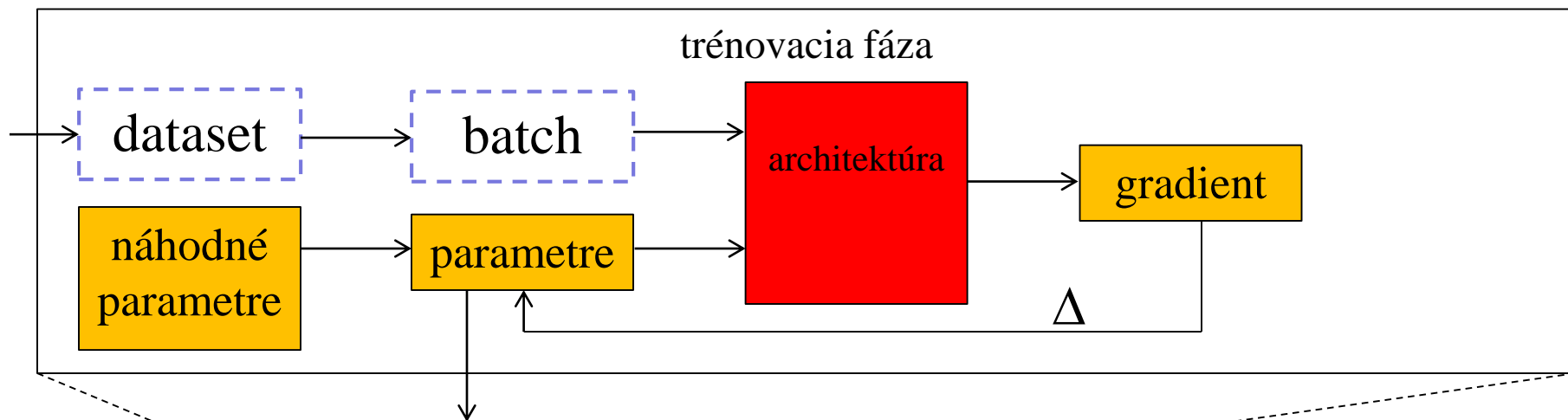


Neurónová sieť

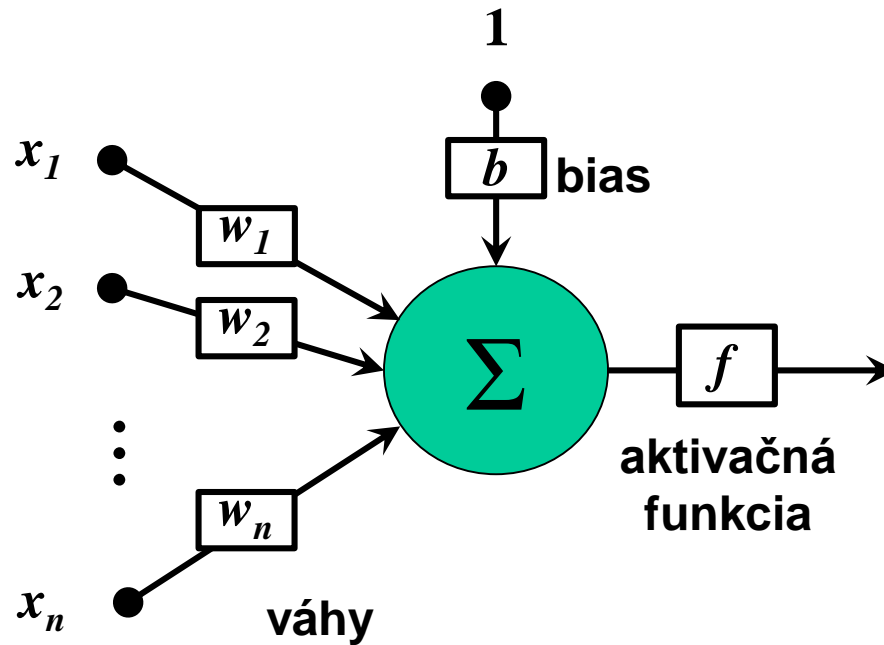
= čokoľvek, majúce parametre, pri ktorom z chyby výstupu vieme povedať, ako meniť tieto parametre, aby sa chyba zmenšila



- Strojové učenie: zo vzorových vstupov a výstupov skonštruujeme model a pomocou tohto modelu transformujeme ďalšie vstupy



Neurón



Tréning neurónu s lineárnou aktiváciou zodpovedá lineárnej regresii

Aktivácia

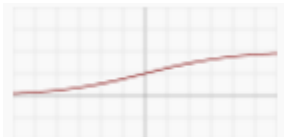
- Na výstup z neurónu je možné aplikovať aktivačnú funkciu

linear



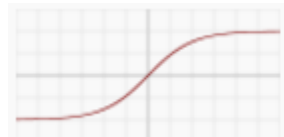
$$f(x) = x$$

sigmoid



$$f(x) = \frac{1}{1 + e^{-x}}$$

tanh



$$f(x) = \tanh(x) = \frac{2}{1 + e^{-2x}} - 1$$

relu



$$f(x) = \begin{cases} 0 & \text{for } x < 0 \\ x & \text{for } x \geq 0 \end{cases}$$

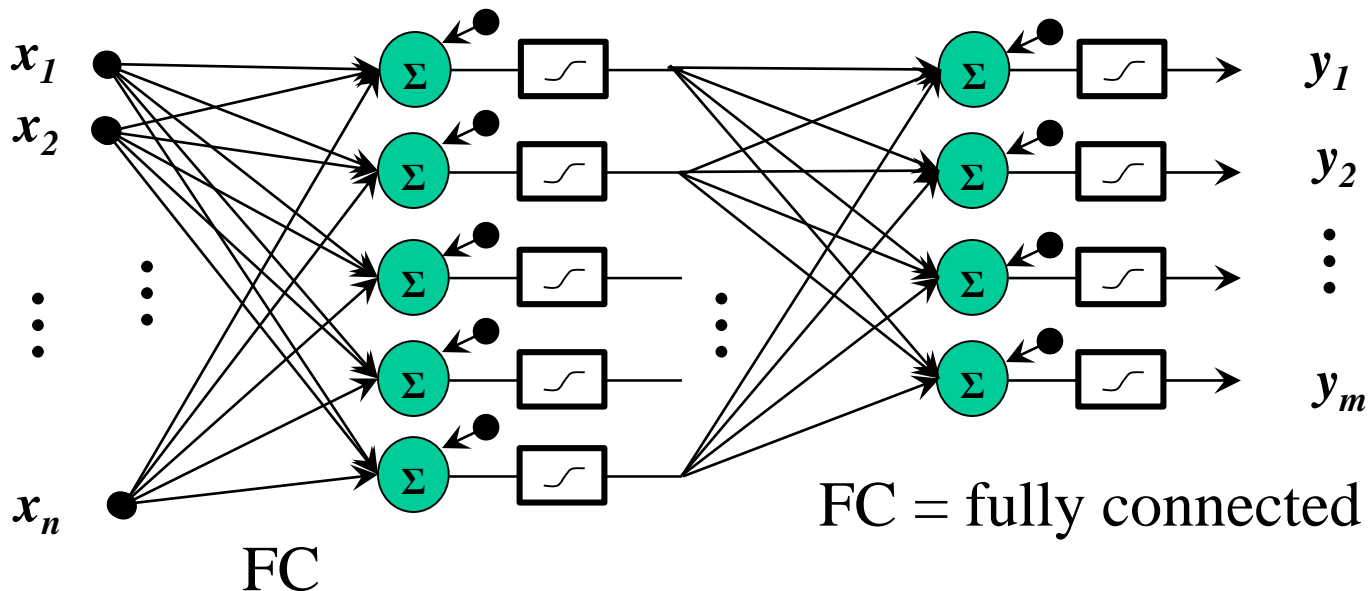
softmax

$$\begin{bmatrix} 1.2 \\ 0.9 \\ 0.4 \end{bmatrix} \xrightarrow{\text{Softmax}} \begin{bmatrix} 0.46 \\ 0.34 \\ 0.20 \end{bmatrix}$$

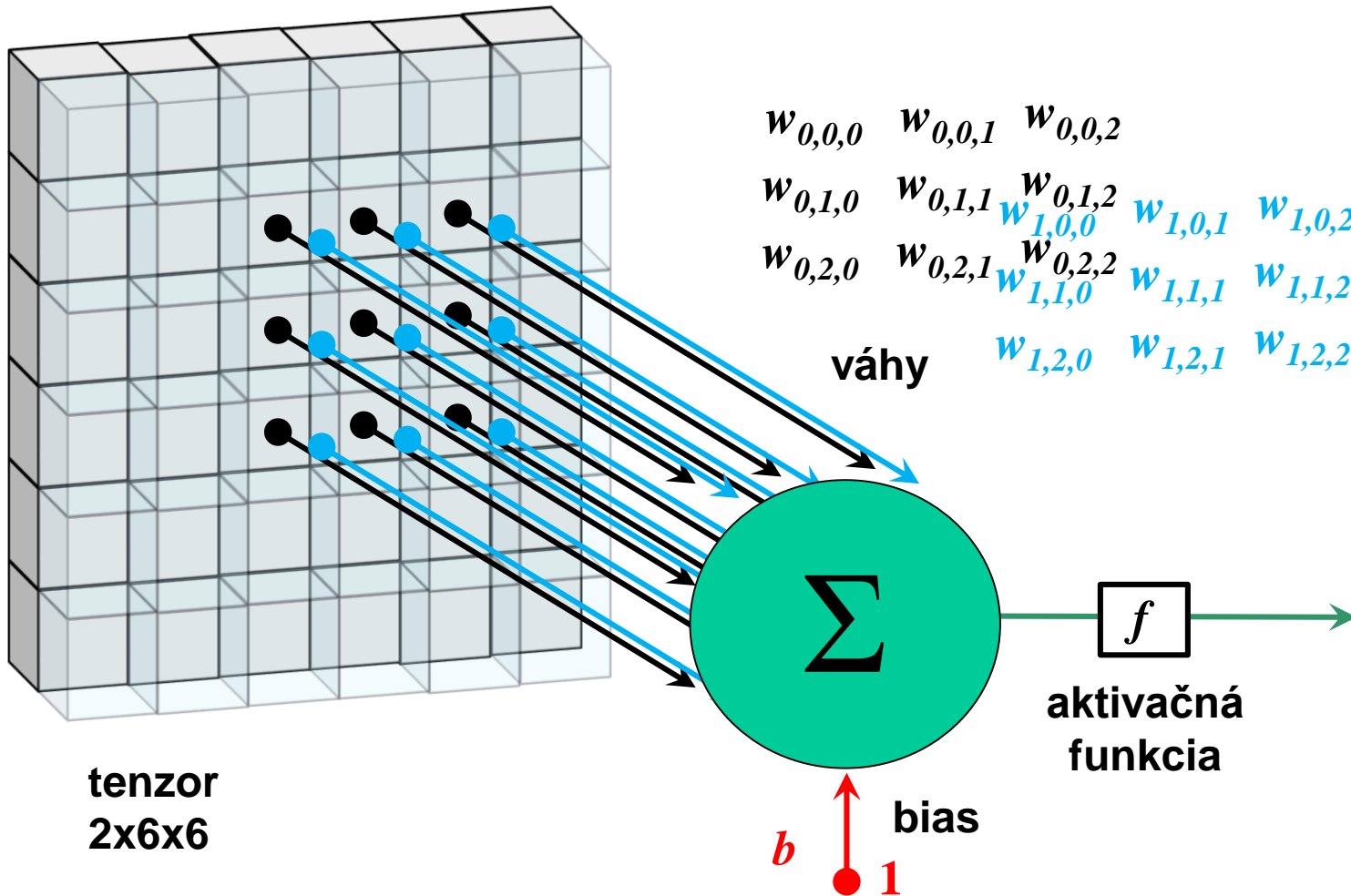
$$\sigma(z)_j = \frac{e^{z_j}}{\sum_{k=1}^K e^{z_k}}$$

Perceptron

- Neurónová sieť z minimálne dvoch plne prepojených vrstiev
- Z teoretického hľadiska je univerzálnym aproximátorom



Kernel



Typické rozmery kernelov: 1x3x3, 3x3x3, 64x3x3, 32x5x5

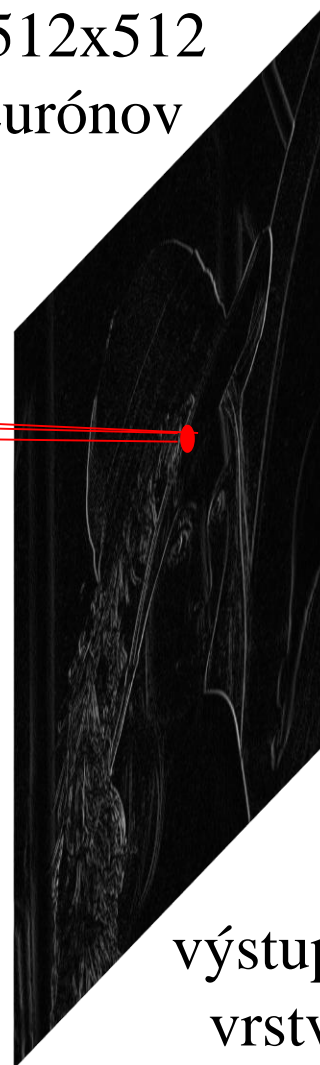
Konvolučná vrstva

1x512x512
neurónov



vstupná
vrstva

1x512x512
neurónov



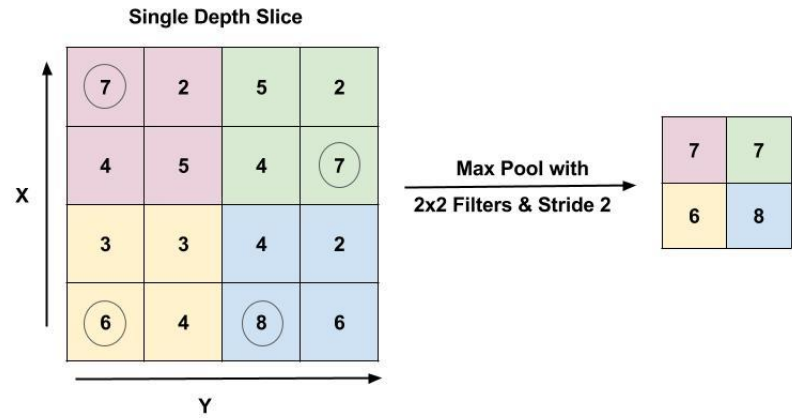
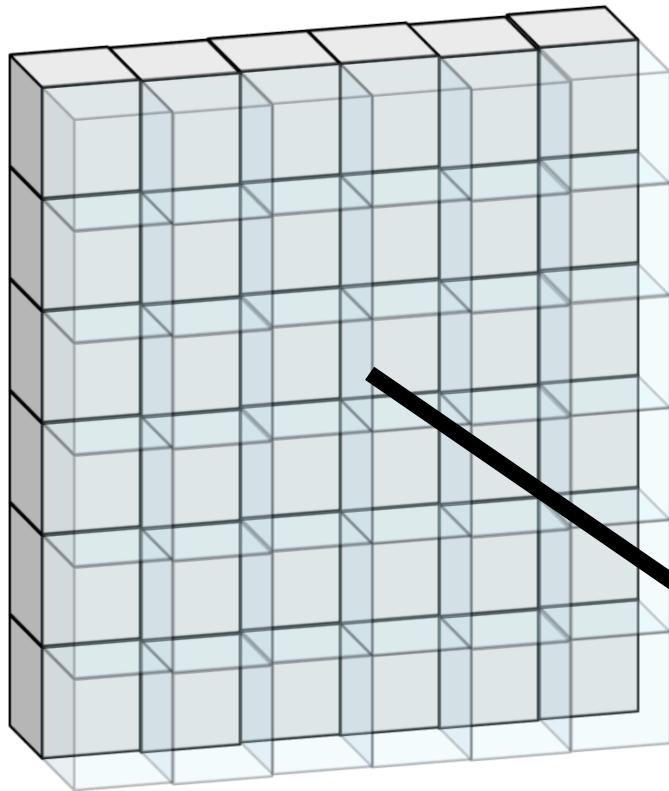
výstupná
vrstva

kernel 1x3x3

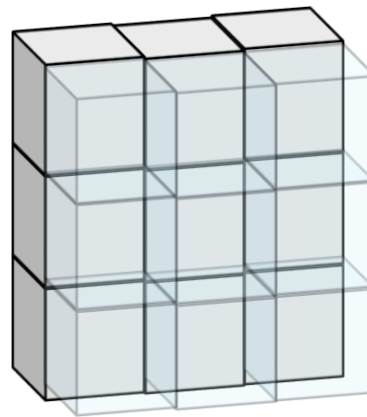


Každý neurón
výstupnej vrstvy
má spojenia na
 $1 \times 3 \times 3 = 9$
neurónov
vstupnej vstvy
Každý neurón má
na spojeniach
rovnaké váhy, tj.
sieť má 9
parametrov,
prípadne 10
s biasom

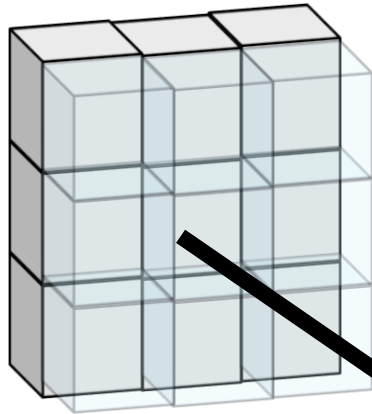
Max Pooling



MaxPooling2D 2x2 stride=2



Up Sampling



Nearest Neighbor

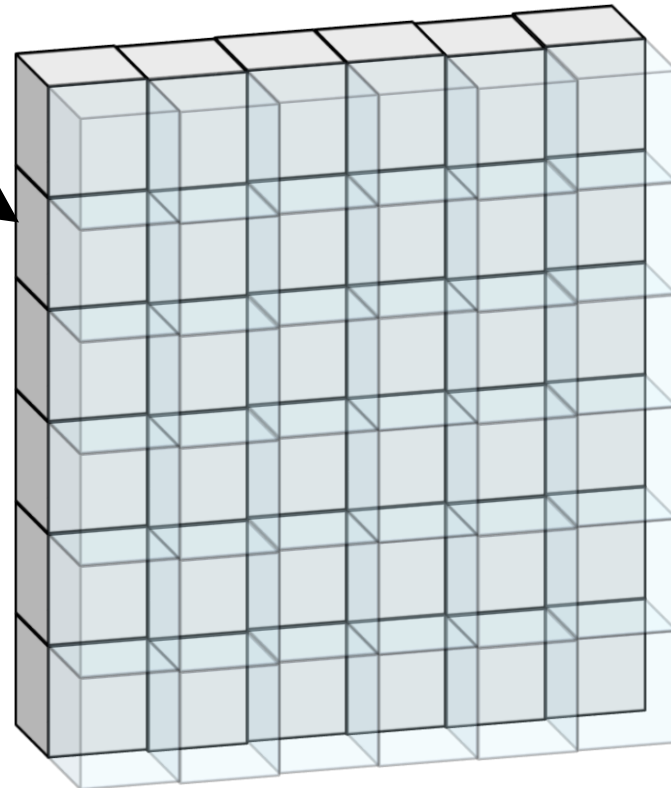
1	2
3	4



1	1	2	2
1	1	2	2
3	3	4	4
3	3	4	4

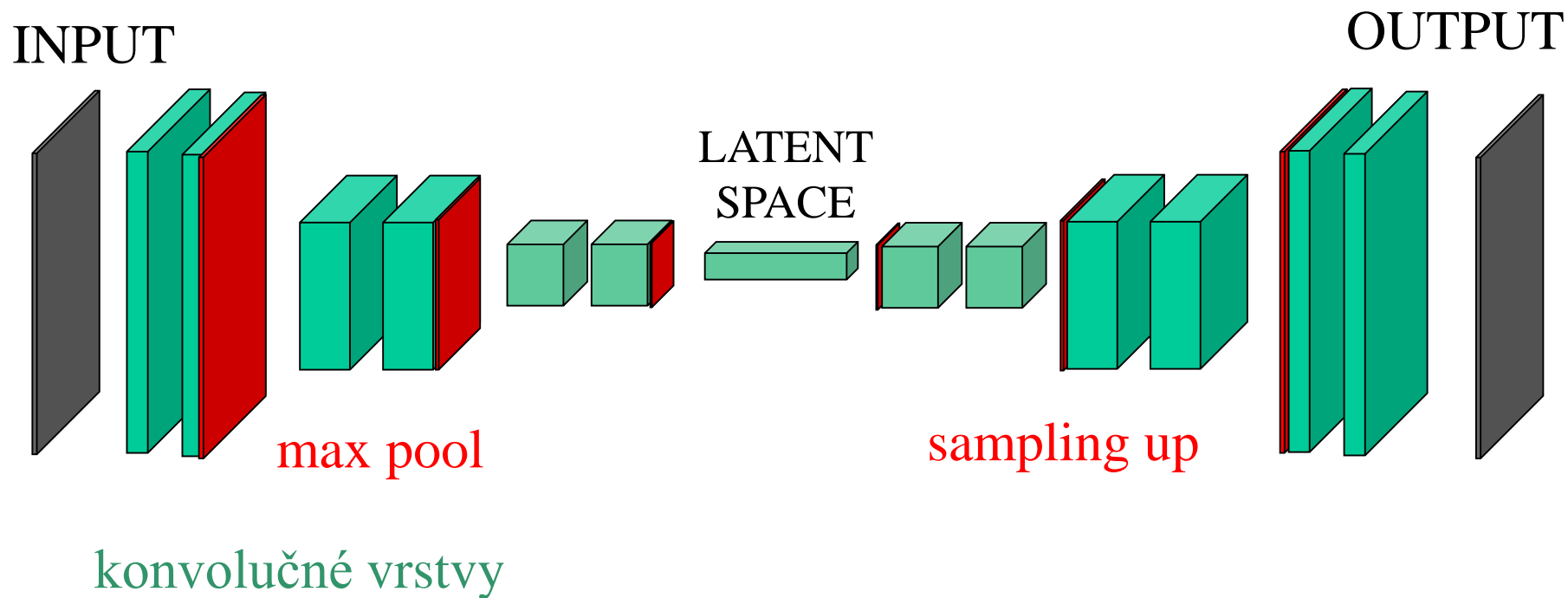
Input: 2 x 2

Output: 4 x 4

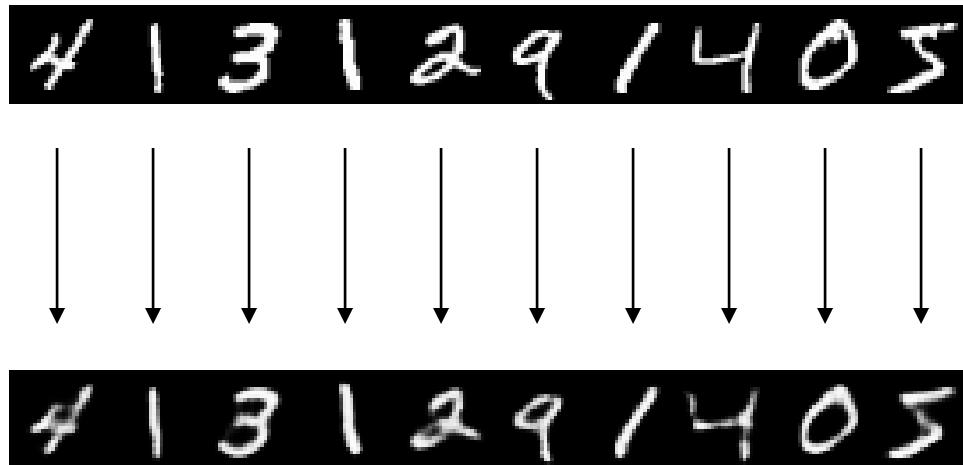


UpSampling2D 2x2 stride=2

(Konvoluční) autoencoder



Autoencoder



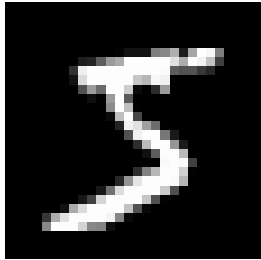
Dataset MNIST

Autoencoder

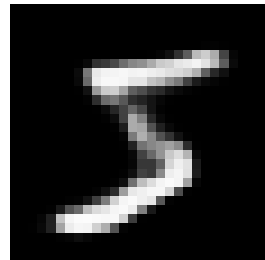
LATENT SPACE

```
array([[0.11400187, 0.47539777, 0.19979003, 0.03328802, 0.29702646,
0.6671412, 0.77884567, 0.98671937, 0., 0.7643514,
0.37023163, 1.1198556, 0.9364344, 0.27932528, 1.3840352,
1.1025171, 0., 1.127322, 0.6720804, 1.0088537,
0.91483283, 0., 1.3498058, 0.8023532, 0.13444054,
1.1076059, 0.805897, 0.4363817, 0.4396257, 0.,
0.5863744, 0.41566792, 0.22631842, 0.20689899, 0.28988916,
0.19635512, 0.92697734, 0.8330982, 0.8810159, 0.14809921,
0., 0.20924592, 0., 2.7036035, 1.7514778,
0.84079874, 1.6247051, 0., 0.25012553, 0.70244396,
0.6414403, 2.4568624, 1.4004446, 0., 1.3100656,
0., 0.5075829, 0.68791926, 0.65375787, 0.82646245,
0.4355916, 0., 0.19816275, 0., 0.,
0.4575198, 0.18170735, 0.12635085, 0.17334037, 0.4582858,
1.0187354, 0.75260663, 0., 0.4846586, 0.,
1.9696081, 1.12253, 0.8872602, 1.3111267, 0.,
0., 1.1081457, 0.5976082, 2.1433632, 1.2630261,
0., 1.4435332, 0., 0.43087044, 0.50078976,
0.85700417, 0.23156954, 0.3238153, 0.19322284, 0.23595949,
0., 0., 0.11734977, 0., 0.8126336,
1.2869604, 0.65106845, 1.012244, 0., 0.07893795,
0.16735056, 0.15048887, 2.1369095, 1.2226689, 0.,
1.0082622, 0., 0.9999559, 0.35816067, 0.4425221,
1.7548463, 0.36668733, 0.25854337, 0.35278222, 0.,
0.7470093, 0.42634767, 0.5120847, 0.24160625, 0.23943251,
0.61216664, 0.171287, 0.35395604], dtype=float32)
```

INPUT

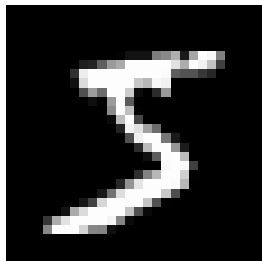


OUTPUT

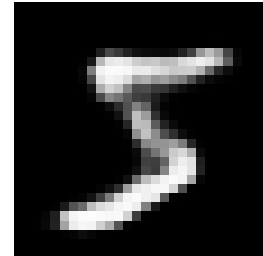


features

Autoencoder



```
array([[0.11400187, 0.47539777, 0.19979003, 0.03328802, 0.29702646,
0.6671412, 0.77884567, 0.98671937, 0., 0.7643514,
0.37023163, 1.1198556, 0.9364344, 0.27932528, 1.3840352,
1.1025171, 0., 1.127322, 0.6720804, 1.0088537,
0.91483283, 0., 1.3498058, 0.8023532, 0.13444054,
0.5 - 1.1076059, 0.805897, 0.4363817, 0.4396257, 0.,
0.5863744, 0.41566792, 0.22631842, 0.20689899, 0.28988916,
0.19635512, 0.92697734, 0.8330982, 0.8810159, 0.14809921,
0., 0.20924592, 0., 2.7036035, 1.7514778,
0.84079874, 1.6247051, 0., 0.25012553, 0.70244396,
0.6414403, 2.4568624, 1.4004446, 0., 1.3100656,
0., 0.5075829, 0.68791926, 0.65375787, 0.82646245,
0.4355916, 0., 0.19816275, 0., 0.,
0.4575198, 0.18170735, 0.12635085, 0.17334037, 0.4582858,
1.0187354, 0.75260663, 0., 0.4846586, 0.,
1.9696081, 1.12253, 0.8872602, 1.3111267, 0.,
0., 1.1081457, 0.5976082, 2.1433632, 1.2630261,
0., 1.4435332, 0., 0.43087044, 0.50078976,
0.85700417, 0.23156954, 0.3238153, 0.19322284, 0.23595949,
0., 0., 0.11734977, 0., 0.8126336,
1.2869604, 0.65106845, 1.012244, 0., 0.07893795,
0.16735056, 0.15048887, 2.1369095, 1.2226689, 0.,
1.0082622, 0., 0.9999559, 0.35816067, 0.4425221,
1.7548463, 0.36668733, 0.25854337, 0.35278222, 0.,
0.7470093, 0.42634767, 0.5120847, 0.24160625, 0.23943251,
0.61216664, 0.171287, 0.35395604], dtype=float32)
```



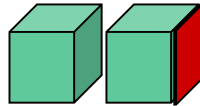
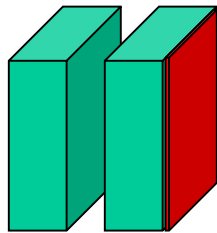
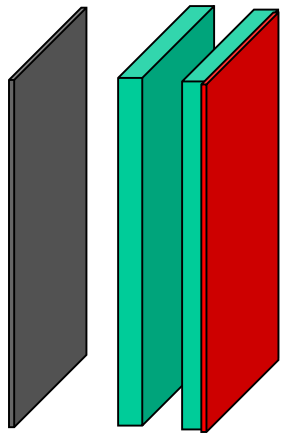
Encoder

Decoder

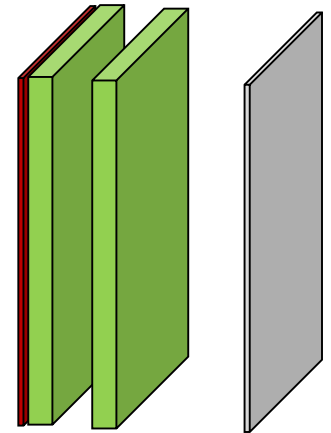
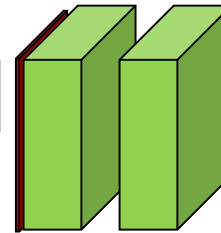
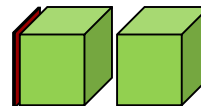
Generátor

Encoder - Decoder

INPUT



LATENT SPACE



OUTPUT

„½ AUTOENCODER“

„½ AUTOENCODER“

Príklad použitia encoder-decoder: Ofarbenie

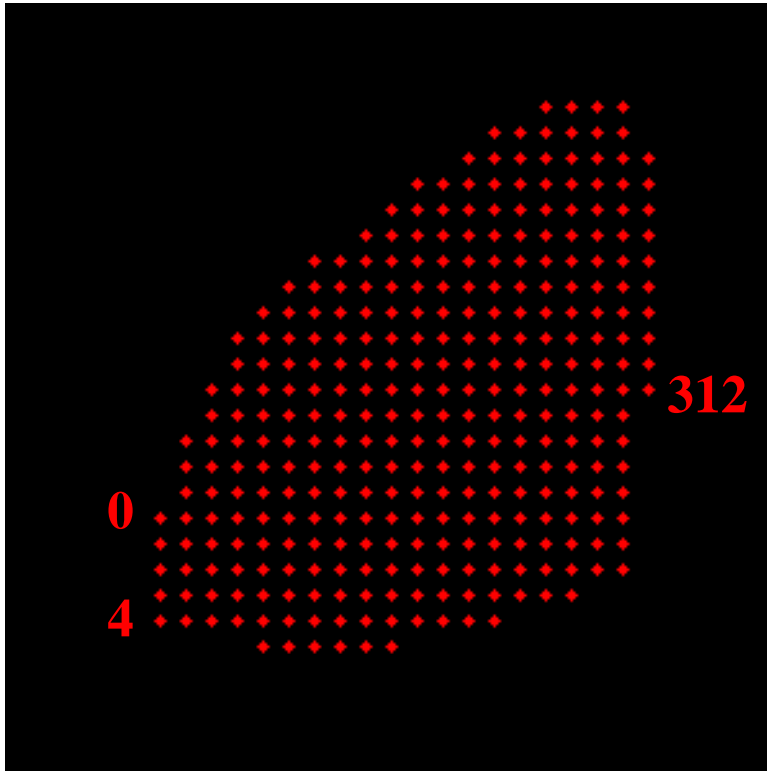


Farebný model

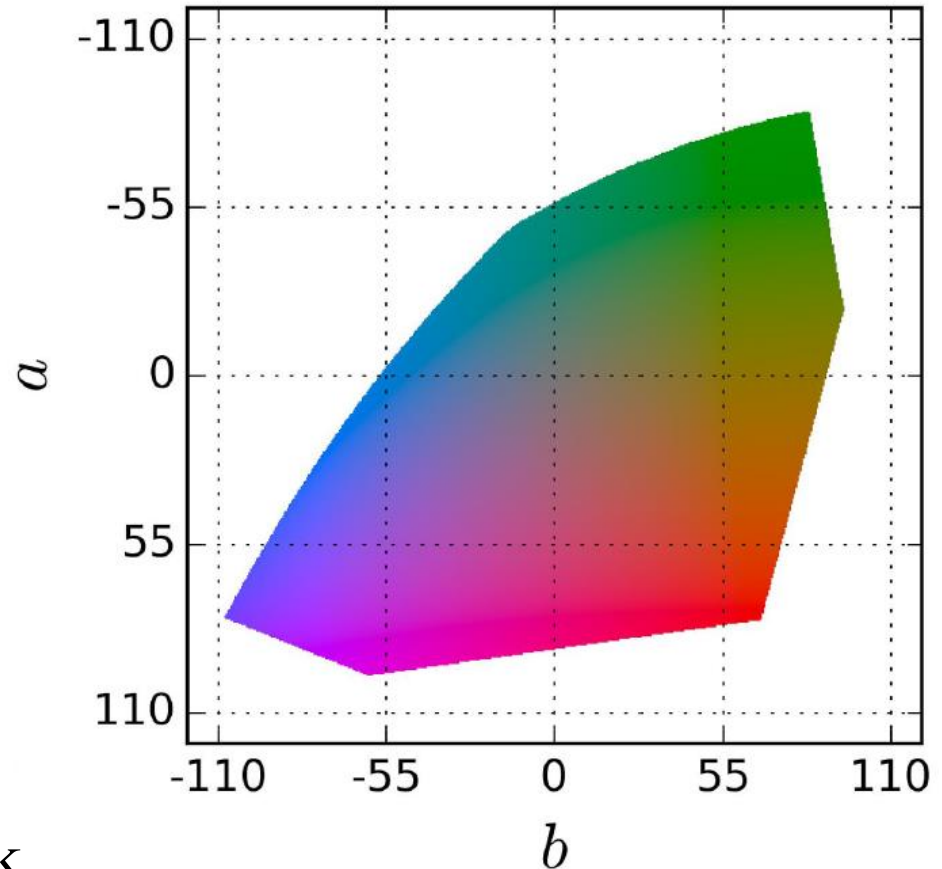
CIE Lab

L .. Intenzita (šedotónový obr.)

Colors in ab space
(continuous)



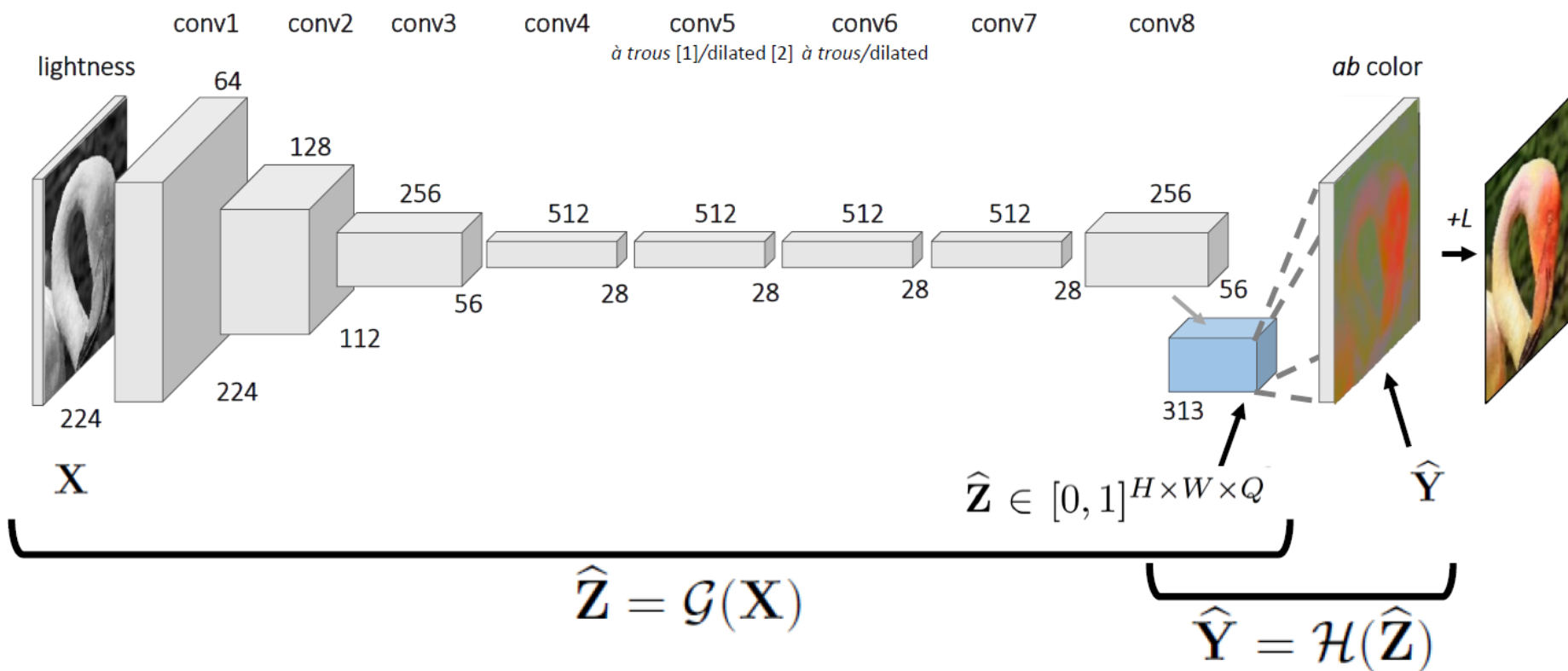
diskretizácia farebných zložiek
farba = vektor 313
pravdepodobností



a .. green-red b .. blue-yellow

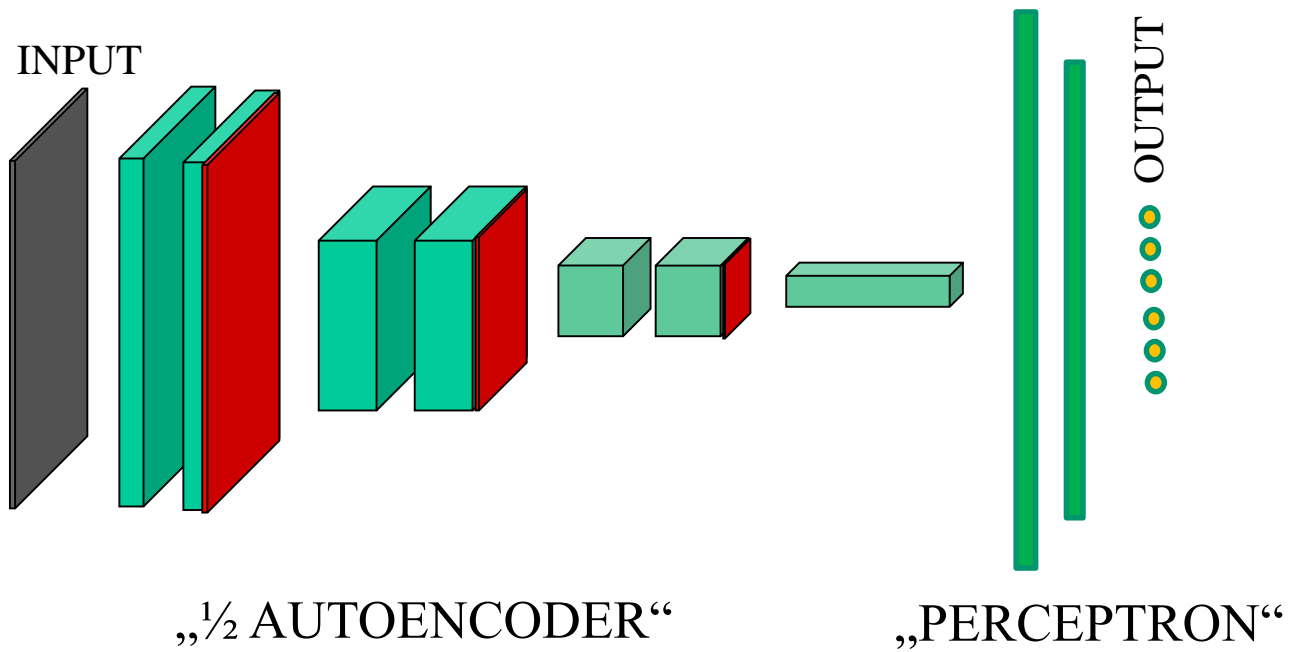
Ofarbenie šedotónových obrázkov

Network Architecture

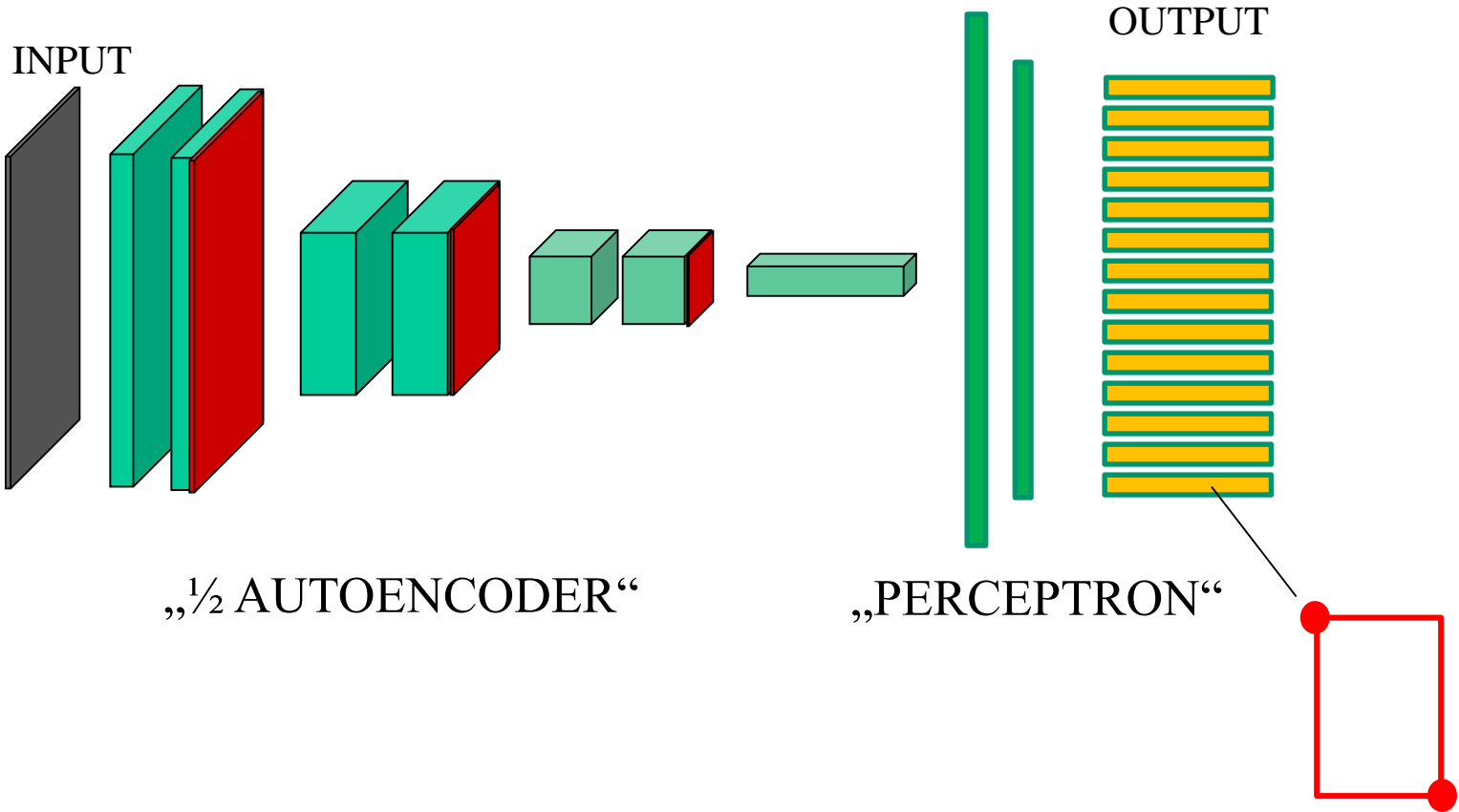


[1] Chen *et al.* In arXiv, 2016.
 [2] Yu and Koltun. In ICLR, 2016

Klasifikátory



Detektor



Sémantická segmentácia



Dataseť:

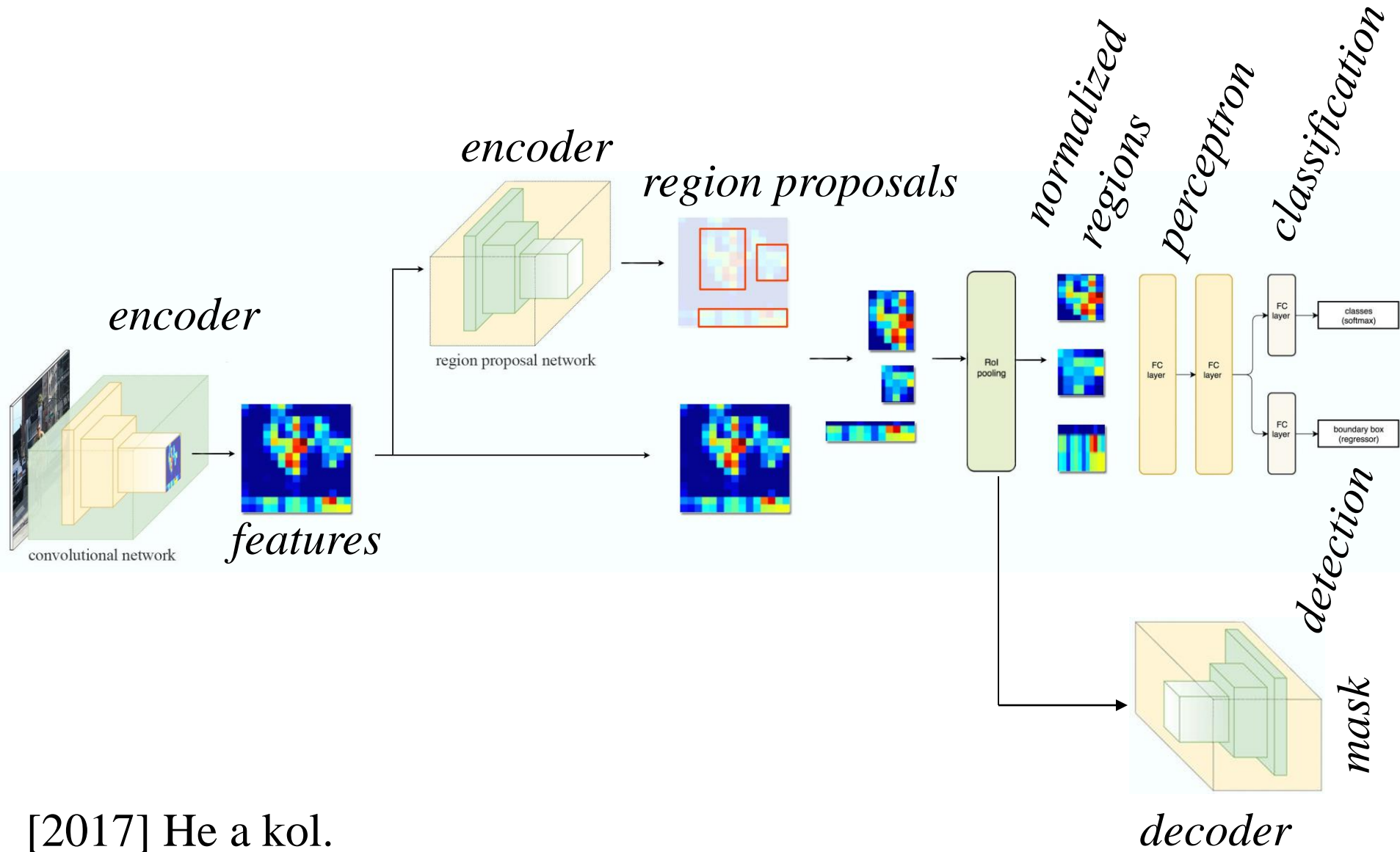
Cityscapes www.cityscapes-dataset.com

Caltech lanes www.mohamedaly.info/datasets/caltech-lanes

COCO cocodataset.org

PASCAL VOC 2012

Mask-RCNN

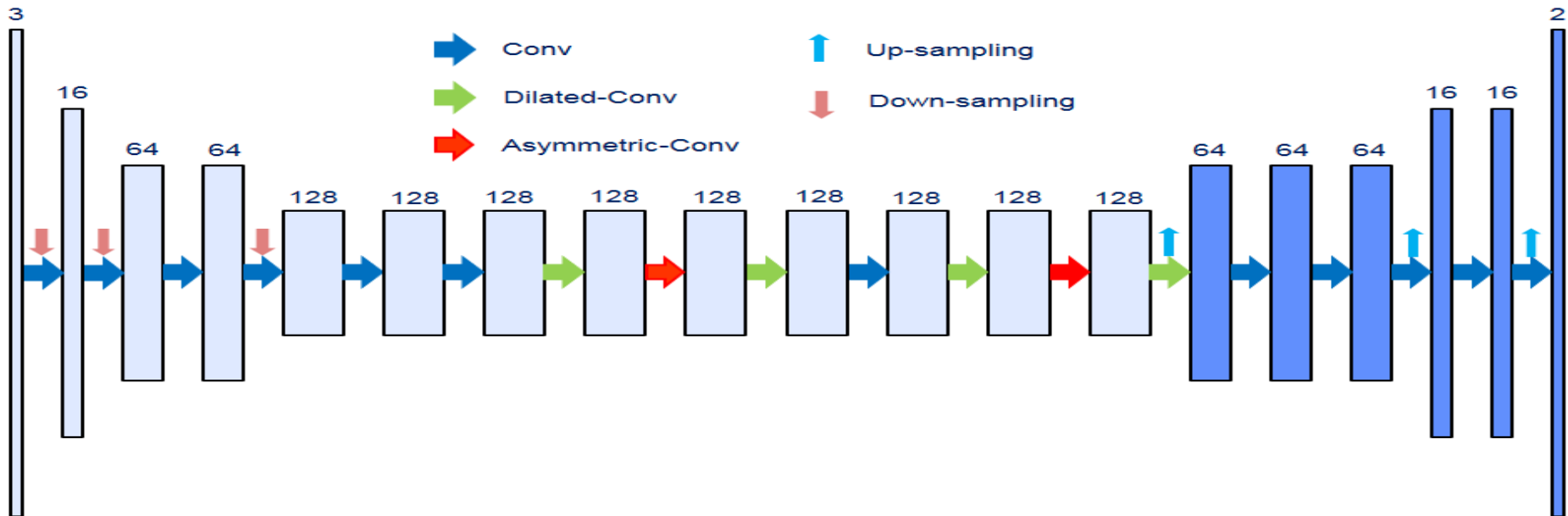
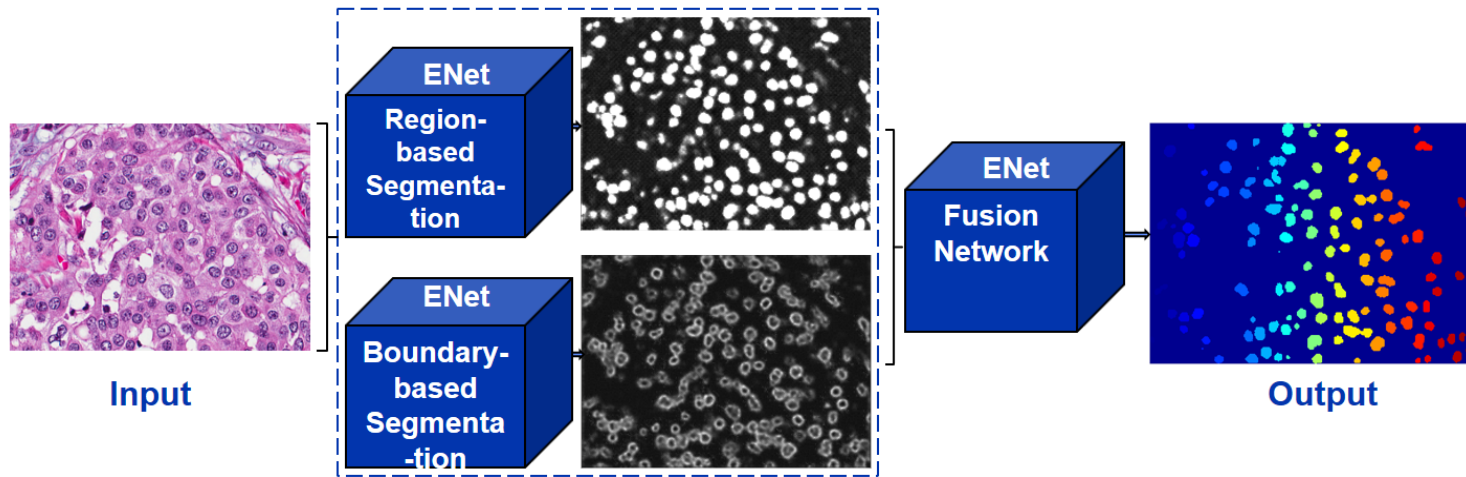


[2017] He a kol.

Mask-RCNN



ENet

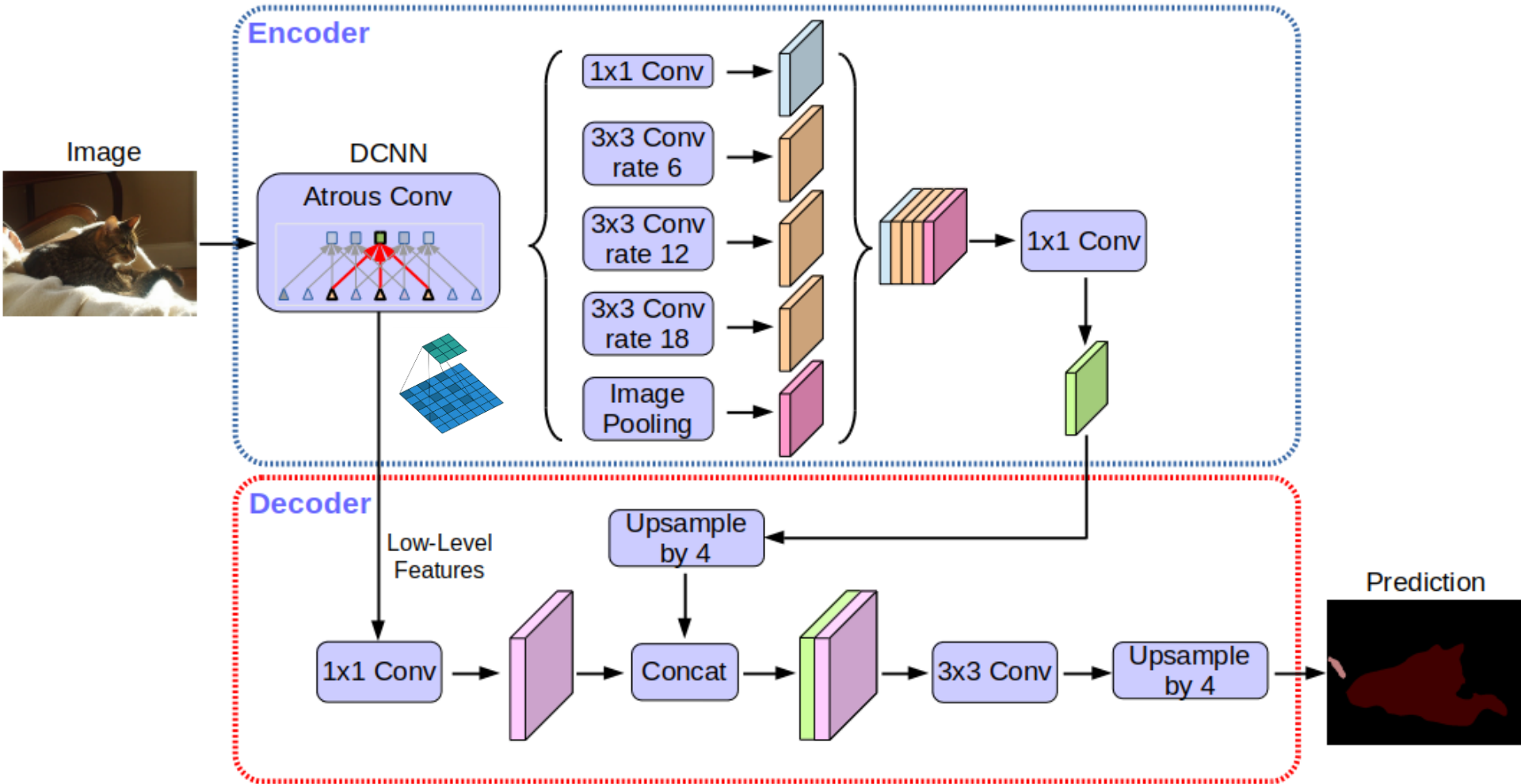


[2018] Khoshdeli a kol.

ENet



DeepLab v3+



[2018] Chen a kol.

DeepLab v3+



Ďakujem za pozornosť!

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www.robotika.sk/seminar-archiv.php#cvicenie12

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